Financing the Maintenance of the National System of Interstate and Defense Highways

By Matthew J. Kulick

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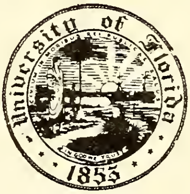

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– FOREWORD –

This publication is another of the efforts of the Bureau of Government Research to make available to the interested public the fruits of research carried out by practicing administrators and students enrolled in the Bureau's academic program leading to the degree of Master of Public Administration.

The author of the current study, Mr. Matthew J. Kulick, is the Deputy Director of the Rhode Island State Department of Public Works. He has become intimately familiar with federally-aided highway construction programs over a long period of service.

Mr. Kulick's concern in this study is shared by state highway administrators all over the nation, though perhaps not all will sympathize with his solutions. But every state highway official knows something which has not yet received attention from the general public — that the Interstate Highway System, so favorably viewed by the motoring public and indeed by many nations of the world, will shortly become a staggering financial burden to the states. As Mr. Kulick makes clear, the law creating the Interstate System and providing 90 per cent federal financing for its construction, required the states to assume not only the burden of administering that system's maintenance, but also paying its cost. In the rush to appraise the system's impact upon our economy and our society, highway users have not stopped to think how the cost of *maintaining* a $41,000,000,000 highway system will be paid. This is precisely Mr. Kulick's concern. He is concerned with the policy decision as to who should pay and with the administrative decisions necessary for sharing the financial burdens.

There is considerable evidence contained in this study to support the contention that the states will not be able, by themselves, to bear the burden of maintaining the Interstate Highway System. There is ample evidence all around us to prove that the states, generally speaking, cannot afford to maintain their present highway systems at levels satisfactory to the motoring public. It is Mr. Kulick's purpose to show that the federal government should revise its laws to assist the states in maintenance of the Interstate System. He takes it for granted that increasing interest in this question will result in the decision by the federal government to undertake this form of assistance to the states. He is concerned with putting such a system of aid into operation once the decision has been made, and, as the study makes clear, it will not be a simple matter.

The author advocates the proposition that the Interstate System be exempted from federal statutes making states solely responsible for the maintenance of federal aid highways. This proposition is based on the present demand for the highway dollar at the state and local level. If a state fails in its responsibility to maintain the system because of financial difficulties, the only recourse the federal government has is to withhold all federal aid from the delinquent state until the state conforms to the mandatory maintenance requirement. The withdrawal of federal aid will only compound the problem. What is needed is a positive form of action, not a negative one.

To protect its investment in the Interstate System, the federal government must assume an active role in the maintenance of the Interstate System. The federal government has the necessary device available in the form of the Highway Trust Fund into which taxes from the highway user are funneled. State highway administrators have the necessary administrative and maintenance forces already trained and available to implement the proposal that the federal government pay for the maintenance of the Interstate System. The continuation of the federal-state partnership in the maintenance of the Interstate System, as in the design and construction of the system, is a policy decision that must be made soon.

The reader interested merely in highways or in the mechanics of administration will find these problems dealt with and answered in this study. (He will also find a good, brief description of the interstate highway program in Chapter I.) We hope this study will contribute a basis for discussion and for resolving what promises to be a significant national problem.

W. Roy Hamilton
Assistant Director

CHAPTER I

THE INTERSTATE HIGHWAY SYSTEM

Maintenance: Sole Responsibility of the States

Maintaining the National System of Interstate and Defense Highways is the sole responsibility of the states. If a state fails to maintain a highway to the satisfaction of the federal government, the Secretary of Commerce has the authority to withhold approval of proposed projects in the state until the maintenance of the highway in question satisfies the federal government. There is no doubt that the requirement of maintenance by the states is mandatory and that the federal government has the power to enforce the regulation. The following is extracted from Title 23, United States Code,[1] referring to the states' responsibility of maintaining the National System of Interstate and Defense Highways:

> a) . . . it shall be the duty of the State highway department to maintain, or cause to be maintained, any project constructed under the provisions of this chapter or constructed under the provisions of prior Acts. The State's obligation to the United States to maintain any such project shall cease when it no longer constitutes a part of a Federal-aid system . . .
>
> c) If at any time the Secretary shall find that any project constructed under the provisions of this chapter, or constructed under the provisions of prior Acts, is not being properly maintained, he shall call such fact to the attention of the state highway department. If, within ninety days after receipt of such notice, such project has not been put in proper condition of maintenance, the Secretary shall withhold approval of further projects of all types in the entire State until such project shall have been put in proper condition of maintenance, unless such project is subject to an agreement pursuant to subsection (b) of this section, in which case approval shall be withheld only for secondary or urban projects in the county or municipality where such project is located.[1]

The American Association of State Highway Officials is in agreement with the federal requirement. The following is extracted from the *1962 Policy Statement* of the Association:

> 3. That upon the completion of a federal-aid project, the road which belongs to the State and is maintained entirely at State expense should be policed, operated and maintained completely by the State and without any federal requirements other than those set out in Sections 111 and 116, Title 23 United States Code, Highways.[1] The States have effective means of achieving the desired degree of uniformity in signing, marking, speed

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[1] *United States Code, Title 23, Highways* and *Section 116, Maintenance,* p. 12 (Washington: Government Printing Office, 1958).

regulation, vehicle weight and size control, law enforcement, etc., to adequately serve the public interest and to make any nationalization in this area unnecessary.[1]

There is no disagreement between federal and state highway officials that the maintenance of the Interstate System is the responsibility of the states. They agree that the existing requirement is one that will produce the best results under all conditions, but the approaching financial burden of this requirement is not yet fully appreciated.

WHAT IS THE SYSTEM?

The National System of Interstate and Defense Highways crisscrosses the United States with 41,000 miles of freeways and is designed to link together 90 per cent of the urban areas having a population of 50,000 or more. It has been planned to serve more than half of the urban population and almost half of the rural population of the country, allowing a motorist to drive from coast to coast without once stopping for a traffic light or stop sign since interchanges, overpasses and underpasses will be constructed to eliminate all grade crossing. The Interstate System is scheduled for completion by 1972 and is designed to handle the full traffic volumes anticipated in 1975.

System Mileage

Table I shows the mileage of the Interstate System allotted to each state and to the District of Columbia. A study of the table shows that 16 states have a mileage in excess of 1,000 miles. The State of Texas leads with 3,026.5 miles while California can claim second place with 2,178.2 miles. Three states, Delaware (40.5 miles), Hawaii (48.5 miles), and Rhode Island (70.9 miles) have less than 100 miles each, mainly due to their size.

The system is limited by law to 41,000 miles. Future needs may dictate that the system be expanded but only a reappraisal after the system has been completed will show whether it is in the national interest to extend the system.

Design Specifications

Design specifications were developed by the American Association of State Highway Officials and approved by the Bureau of Public Roads.[2]

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[1] This four-page policy statement was distributed to the entire membership. It was developed and adopted by the chief administrative officers of the state highway departments at a meeting held in Denver, Colorado, October 8, 1961.

[2] Design Specifications are included in a five-page mimeographed brochure, *Geometric Design Standards for the National System of Interstate and Defense Highway* COMM-DC-10885, adopted by AASHO, July 12, 1956, and approved by the Bureau of Public Roads, July 17, 1956.

TABLE I

NATIONAL SYSTEM OF INTERSTATE AND DEFENSE HIGHWAYS MILEAGE IN STATES*

State	Total Designated System Mileage	State	Total Designated System Mileage
Alabama	874.8	Nebraska	489.8
Alaska	——	Nevada	534.0
Arizona	1,161.0	New Hampshire	213.8
Arkansas	517.8	New Jersey	375.9
California	2,178.2	New Mexico	1,005.2
Colorado	948.0	New York	1,227.2
Connecticut	293.4	North Carolina	768.8
Delaware	40.5	North Dakota	567.9
Florida	1,120.0	Ohio	1,495.2
Georgia	1,103.6	Oklahoma	794.0
Hawaii	48.5	Oregon	731.3
Idaho	612.1	Pennsylvania	1,575.5
Illinois	1,586.5	Rhode Island	70.9
Indiana	1,120.9	South Carolina	678.9
Iowa	708.6	South Dakota	678.8
Kansas	801.1	Tennessee	1,047.6
Kentucky	696.1	Texas	3,026.5
Louisiana	682.6	Utah	934.9
Maine	312.0	Vermont	323.9
Maryland	353.7	Virginia	1,053.1
Massachusetts	462.4	Washington	725.6
Michigan	1,077.9	West Virginia	522.7
Minnesota	898.1	Wisconsin	452.5
Mississippi	678.2	Wyoming	914.6
Missouri	1,104.7	District of Columbia	28.1
Montana	1,180.4		

*Source: United States Department of Commerce, Bureau of Public Roads, *Quarterly Report on the Federal-Aid Highway Program,* June 30, 1962 (Washington: Government Printing Office, 1962), Table I.

Design Speed

The design speed of all highways on the system shall be at least 70, 60 and 50 miles per hour for flat, rolling, and mountainous topography, respectively, and depending upon the nature of terrain and development. The design speed in urban areas should be at least 50 miles per hour.

Gradients

For design speeds of 70, 60 and 50 miles per hour, gradients generally shall be not steeper than three, four, and five per cent, respectively. Gradients two per cent steeper may be provided in rugged terrain.

Width and Number of Lanes

Traffic lanes shall not be less than 12 feet wide.

Medians

Medians in rural areas in flat and rolling topography shall be at least 36 feet wide. Medians in urban and mountainous areas shall be at least 16 feet wide. Narrower medians may be provided in urban areas of high right-of-way cost, on long and costly bridges, and in rugged mountainous terrain, but no median shall be less than four feet wide.

Curbs or other devices may be used where necessary to prevent traffic from crossing the median.

Shoulders

Shoulders usable by all classes of vehicles in all weather shall be provided on the right of traffic. The usable width of shoulder shall be not less than 10 feet. In mountainous terrain involving high cost for additional width, the usable width of shoulder may be less but at least six feet. Usable width of shoulder is measured from edge of through-traffic lane to intersection of shoulder and fill or ditch slope except where such slope is steeper than 4:1 where it is measured to beginning of rounding.

Slopes

Side slopes should be 4:1 or flatter where feasible and not steeper than 2:1 except in rock excavation or other special conditions.

Right-of-Way

Fixed minimum widths of right-of-way are not given because wide widths are desirable, conditions may make narrow widths necessary, and right-of-way need not be of constant width. The following minimum widths are given as guides.

In rural areas right-of-way widths should be not less than the following, plus additional widths needed for heavy cuts and fills:

	Minimum Width in Feet	
Type of Highway	*Without Frontage Roads*	*With Frontage Roads*
2-lane	150	250
4-lane divided	150	250
6-lane divided	175	275
8-lane divided	200	300

In urban areas right-of-way width shall be not less than that required for the necessary cross section elements, including median, pavements, shoulders, outer separations, ramps, frontage roads, slopes, walls, border areas, and other requisite appurtenances.

Culverts

All culverts shall be of sufficient length to accommodate the pavements, median, and shoulders.

Bridge and Other Structures

The clear height of structures shall be not less than 14 feet over the entire roadway width, including the usable width of shoulders. Allowance should be made for any contemplated resurfacing.

Some Relevant Figures

The following figures were obtained from various sources and most are identified as to source. Those not identified are extensions of available information and are used to emphasize the extent of the Interstate System and the problem of maintenance:

Total Cost of Construction[1]	$41,000,000,000
Federal Share of Construction[1]	90 per cent
State Share of Construction[1]	10 per cent
Total Mileage of System[2]	41,000 miles
Mileage in Rural Areas[2]	35,670 miles
Mileage in Urban Areas[2]	5,330 miles
Average Cost per Mile in Rural Areas[2]	$639,000
Average Cost per Mile in Urban Areas[2]	$3,658,000
Number of Interchanges[2]	12,000
Number of Highway and Railroad Separations[2]	22,000
Number of Stream Crossings and Other Bridges[2]	13,000
Miles of Highway Equivalent to Total Mileage of System[2]	170,000 miles
Percentage of 2-lanes in System[2]	6 per cent
Percentage of 4-lanes in System[2]	84 per cent
Percentage of 6-lanes in System[2]	10 per cent
Lane Miles in Rural Areas	138,000 miles
Lane Miles in Urban Areas	32,000 miles

The mileage of lane-miles in rural areas and in urban areas were derived as follows:

Urban portions of system: 13% x 41,000 miles = 5,330 miles
Rural portions of system: 87% x 41,000 miles = 35,670 miles

		Rural	*Urban*
6% of system — 2 lanes	2,460 miles	2,460	——
84% of system — 4 lanes	34,440 miles	33,210	1,230
10% of system — 6, 8 or more	4,100 miles	——	4,100
	41,000 miles	35,670 miles	5,330 miles

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[1] United States Department of Commerce, Bureau of Public Roads, *America's Lifelines, Federal-Aid for Highways* (Washington: Government Printing Office, no date), p. 3.

[2] *Ibid*, p. 10.

Urban lane-miles

1,230 miles x 4 lanes = 4,920
3,100 miles x 6 lanes = 18,600
1,000 miles x 8 lanes = 8,000

31,520 — urban lane-miles, or 32,000

Rural lane-miles

2,460 miles x 2 lanes = 4,920
33,210 miles x 4 lanes = 132,840

137,760 — rural lane-miles, or 138,000

The 41,000 miles of highways in the Interstate System are the equivalent of 170,000 miles of single lane highways of which 32,000 miles are in urban areas and 138,000 miles are in rural areas.

For maintenance purposes, the states will be responsible for the 32,000 miles of highway in urban areas (called hereafter 32,000 urban lane-miles) and the 138,000 miles of highway in rural areas (called hereafter 138,000 rural lane-miles).

Problems and Proposals

Will the states separately and together be able to maintain this system at a total cost which might well approach or exceed $200,000,000 per year,[1] and, at the same time finance the construction and maintenance of other federal-aid highway systems at the level of current requirements?

While a few states are currently conducting individual studies of this problem, this study takes it for granted that many states will be unable to maintain their portions of the Interstate Highway System at adequate levels. There are many reasons for taking this position as a safe assumption, foremost among them being the fact that state highway systems are not, as a rule, adequately maintained at the present time because of lack of funds. This study proposes that federal aid for maintaining the Interstate Highway System must *necessarily* be forthcoming despite the fact that the legislation authorizing construction of the Interstate System specifically requires the states to maintain this system at their own expense.

If it can be accepted, for the present, that federal aid for maintaining the Interstate System will have to be secured, other questions arise. Is there adequate machinery for the administration of such a program? Are the necessary management tools available and can they be employed by highway administrators?

The remainder of this study will show that management tools are available. After a survey of the problems involved, proposals will be outlined which, if a decision to give federal aid should be made, will enable the states and the federal government to implement such a maintenance policy.

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[1] Based on an assumed average cost of $5,000 per mile per year.

CHAPTER II

MAINTENANCE COSTS

The following quotation emphasizes the huge highway maintenance problem facing this country:

> A recent study by the Bureau of Public Roads indicates that highway maintenance will cost, over the next few years, half as much as construction. For the present year, construction was estimated at $5.6 billion and maintenance at $2.8 billion. As our highway investment continues to grow and our traffic increases in speed, volume and probably weight, prompt and effective maintenance will become more and more essential. Money must be made available, along with more men skilled in maintenance and better equipment and materials. To provide these in the near future, leadership in maintenance engineering is necessary and to a degree we have not always had in the past.[1]

Thus, demands upon the highway dollar will continue. Highway administrators at the state level are faced with accumulating demand for maintenance of state and interstate highways. It is axiomatic that as highways are completed, expenditures for construction will decrease and expenditures for maintenance will increase. The end of highway construction is not yet in sight, and maintenance of highways begins the day the ribbon is cut and the highway is opened to traffic.

This problem is aptly brought out in the editorial, "Bogged Down," in *Better Roads* magazine:

> Everyone wants good roads, but no one is anxious to pay for them. This is not only a national dilemma, but a state, city and county one as well. For example, take the Los Angeles County, Calif. This wealthy, fast-growing metropolitan county needs something like $500,000,000 to put all of its roads and streets in top condition. That doesn't include the state freeways.
>
> But, only $36,000,000 is available each year for all cities and the county for roads and streets. Most of the money comes from the state-collected gasoline tax. Gloom hangs over all agencies that have anything to do with roads and streets . . .
>
> Everyone disagrees on how the money should be obtained. The cities want more of the $36,000,000. There's a proposal to raise motor-vehicle fees to obtain more money. Or some people favor another bond issue. There is no agreement on who should pay for the roads. Some say the truckers should pay for most of it; others say that the trucks haul necessities for everyone, therefore, the general taxpayer should pay for the roads.
>
> The people concerned are in agreement on only one thing: The country

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[1] Editorial Viewpoint, "Highway Maintenance Needs and Costs," *Public Works,* 94:7, January, 1963.

needs the roads and must have them. That seems to be the consensus in Washington, too.[1]

The Highway Dollar

This section will examine the sources of the highway dollar and the ways in which the money is expended; the total amount allotted for highway purposes, with the source indicated for selected states; and, the total expenditure, segregated as to class for each state.

Sources of the highway dollar and the expenditures reported by state highway administrators varied from state to state depending upon the organization and its statutory duties and responsibilities. Some states not only made their highway administrators responsible for highways but also imposed upon them, by legislative acts, the responsibility for other state functions such as the administration of state parks, recreational activities and highway patrols to promote highway safety and enforcement.

Table II shows the distribution of total disbursements for state administered highways. A study of the table shows that construction of highways takes more than 50 per cent of the money available while maintenance absorbs a much smaller percentage.

The national average disbursement for construction from Table II is 71.25 per cent and for maintenance, 13.97 per cent. There is no doubt that at present the emphasis is on highway construction. For example, Wyoming is spending above the average for construction (85.6 per cent) and below the average (10.8 per cent) for maintenance.

To illustrate the financial dimensions of the maintenance problem, the following information from primary sources in six states was selected:

1. Total income for highway purposes
2. Expenditures for maintenance — dollars
3. Expenditures for maintenance — percentage
4. Expenditures for construction — dollars
5. Expenditures for construction — percentage

The six states were selected because two each were spending: (1) more than the national average for maintenance purposes; (2) less than the national average; and, (3) approximately at the national average.

Maintenance Expenditure Below National Average[2]

Florida — 7.8 per cent
California — 7.7 per cent

Maintenance Expenditure Approximately at National Average[2]

Alabama — 14.4 per cent
Minnesota — 13.0 per cent

Maintenance Expenditure Above National Average[2]

North Carolina — 30.3 per cent
Maine — 23.2 per cent

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[1] Editorial Viewpoints, "Bogged Down," *Better Roads,* 31:8, May, 1961.

[2] National average for maintenance expenditure — 13.97 per cent:
National average for construction expenditure — 71.25 per cent.

TABLE II

DISTRIBUTION OF TOTAL DISBURSEMENTS FOR STATE ADMINISTERED HIGHWAYS, 50 STATES, 1959*

State	Total Disbursements	Construction	Maintenance	Administration & Miscellaneous	State Highway Police and Safety	Bond Interest	Bond Retirement
			(Per Cent)				
Alabama	100.0	71.4	14.4	2.3	3.1	3.0	5.8
Alaska	100.0	66.6	28.3	4.9	0.2	0.0	0.0
Arizona	100.0	76.8	12.5	6.2	4.5	0.0	0.0
Arkansas	100.0	60.8	18.3	4.6	2.9	4.1	9.3
California	100.0	79.6	7.7	4.5	6.4	1.1	0.7
Colorado	100.0	75.2	11.1	4.2	5.1	1.4	3.0
Connecticut	100.0	50.8	10.8	5.3	2.4	11.4	19.3
Delaware	100.0	53.1	11.4	3.5	3.6	6.0	22.4
Florida	100.0	77.0	7.8	3.0	3.2	4.3	4.7
Georgia	100.0	78.9	10.0	4.2	3.3	0.9	2.7
Hawaii	100.0	73.9	7.1	5.4	0.0	8.6	5.0
Idaho	100.0	72.8	17.3	7.0	2.9	0.0	0.0
Illinois	100.0	78.2	8.4	2.8	3.4	5.2	2.0
Indiana	100.0	70.2	15.1	4.5	3.8	6.4	0.0
Iowa	100.0	82.8	11.5	3.1	2.6	0.0	0.0
Kansas	100.0	71.2	15.7	5.2	2.2	5.7	0.0
Kentucky	100.0	73.7	16.6	3.7	1.9	2.1	2.0
Louisiana	100.0	73.1	9.3	7.4	1.8	2.4	6.0
Maine	100.0	60.7	23.2	3.4	1.6	6.4	4.7
Maryland	100.0	62.6	8.2	3.1	5.0	7.7	13.4
Massachusetts	100.0	55.0	9.1	4.0	2.6	9.1	20.2
Michigan	100.0	72.3	10.8	3.9	3.4	5.4	4.2
Minnesota	100.0	80.0	13.0	2.8	2.8	0.8	0.6
Mississippi	100.0	74.1	10.7	3.3	3.2	3.0	5.7
Missouri	100.0	75.6	16.6	3.8	3.1	0.3	0.6
Montana	100.0	80.6	10.9	5.5	3.0	0.0	0.0
Nebraska	100.0	77.3	15.5	3.6	3.6	0.0	0.0
Nevada	100.0	74.7	16.4	6.8	2.1	0.0	0.0
New Hampshire	100.0	61.9	20.1	10.0	2.0	2.9	3.1
New Jersey	100.0	47.3	17.3	3.1	4.4	15.2	12.7
New Mexico	100.0	76.8	14.3	2.8	1.8	0.5	3.8
New York	100.0	75.0	11.1	2.4	1.3	5.9	4.3
North Carolina	100.0	53.5	30.3	3.7	3.4	1.6	7.5
North Dakota	100.0	83.8	10.3	3.9	2.0	0.0	0.0
Ohio	100.0	75.8	7.8	2.0	2.3	5.3	6.8
Oklahoma	100.0	75.6	11.7	3.4	2.9	3.9	2.5
Oregon	100.0	71.1	13.7	5.9	3.4	1.6	4.3
Pennsylvania	100.0	62.6	14.5	5.5	3.7	4.2	9.5
Rhode Island	100.0	59.7	19.4	6.7	3.4	4.0	6.8
South Carolina	100.0	68.7	14.9	3.0	2.6	0.8	10.0
South Dakota	100.0	81.1	12.4	5.0	1.5	0.0	0.0
Tennessee	100.0	82.4	8.7	5.0	3.3	0.6	0.0

Texas	100.0	79.8	13.8	4.2	1.3	0.4	0.5
Utah	100.0	81.8	10.3	4.3	3.6	0.0	0.0
Vermont	100.0	70.4	15.6	4.0	1.4	1.4	7.2
Virginia	100.0	58.5	23.5	6.5	5.7	4.6	1.2
Washington	100.0	67.9	15.0	3.6	4.8	4.2	4.5
West Virginia	100.0	66.9	19.8	1.3	1.3	3.9	6.8
Wisconsin	100.0	77.5	15.5	4.0	2.6	0.0	0.4
Wyoming	100.0	85.6	10.8	1.9	1.7	0.0	0.0

*Sources: Highway Statistics, 1959, Advance Sheets, and University of Mississippi, Bureau of Governmental Research School of Business and Government, *Money for Miles in Mississippi, A Highway Finance Report to the Legislative Highway Planning Committee,* (Jackson, Miss. 1961), p. 123.

The following detailed analysis of the six states selected as samples will illustrate. The material is based on reports of state highway administrators.

FLORIDA

Biennial Report 1959-1960[1]

Sources of Revenue

Federal Aid	33¢
Toll Collections	2¢
Sale of Bonds	14¢
Other	4¢
First Gas Tax — 4¢	30¢
80% Surplus of 5th, 6th and 7th cent	17¢

How Expended

Construction	59¢
Maintenance	7¢
Right-Of-Way	19¢
Lease Purchase Payments	8¢
Preliminary Engineering	2¢
Administration	2¢
Other	3¢

Florida's total interstate mileage is 1,126 miles of which 113 are located in urban areas and the remaining 1,013 miles are located in rural areas.[2]

The State Road Department reported that "each year the Maintenance Division's mowing machines travel a distance equal to 26 times around the earth keeping the highway neat, attractive and serviceable.[3]

Florida, in 1960, reported 10,484 miles of highway in its Primary System (includes interstate mileage) and 4,654 miles in its Secondary System for a total of 15,138 miles that must be maintained.[4]

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[1] Florida State Road Department, *Twenty-Third Biennial Report* (Tallahassee, Florida), p. 4.

[2] *Ibid,* p. 11.

[3] *Ibid,* p. 17.

[4] *Ibid,* p. 20.

Statement of Maintenance and Construction[1]

Summary — As of June 30, 1960

Maintained Length

Highways:		Bridges:
Primary System	10,484.222 miles	716,010 feet
Secondary System	4,664.791 miles	77,402 feet
	15,149.013 miles	793,412 feet

Maintenance Cost:

July 1, 1958 — June 30, 1959	$17,000,840.60
July 1, 1959 — June 30, 1960	17,839,250.89

To emphasize the fact that construction and maintenance costs continue to increase each year, the following ten year statistical statement of construction and maintenance costs was included in Florida's Biennial Report.[2]

Year	Construction of Roads and Bridges	Maintenance of Roads and Bridges
1950	$ 39,556,899.74	$ 9,044,089.41
1951	59,602,172.26	11,466,145.65
1952	60,859,218.79	10,784,723.78
1953	4,667,500.06	11,587,755.93
1954	66,506,246.03	14,399,275.64
1955	69,246,268.13	13,417,676.45
To June 30, 1956	34,068,622.38	6,615,520.30
1956-1957	99,061,645.90	13,590,479.25
1957-1958	109,951,714.25	16,611,917.74
1958-1959	148,922,223.05	17,000,840.60
1959-1960	179,703,986.41	17,839,250.89

CALIFORNIA

Fiscal Year 1960-1961[3]

State Highway Budget

1960-1961	$569,244,000
1961-1962	633,460,000
1962-1963	658,370,017

Construction (including Right-of-Way)

1960-1961	$452,785,000
1961-1962	509,078,000
1962-1963	527,792,917

Maintenance Expenditures[4]

July 1, 1957-June 30, 1958	$30,085,112.54	6.67 per cent
July 1, 1958-June 30, 1959	31,849,561.21	6.11 per cent
July 1, 1959-June 30, 1960	34,275,211.01	7.48 per cent
July 1, 1960-June 30, 1961	37,468,644.55	5.91 per cent
Total to June 30, 1961	$541,201,648.31	10.11 per cent

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[1] Florida State Road Department, *Twenty-Third Biennial Report* (Tallahassee, Florida), p. 65.

[2] *Ibid*, p. 74.

[3] Division of Highways, Department of Public Works, *California Highways and Public Works, Annual Report Issue, November-December 1961* (Sacramento, California).

[4] *Ibid*, Statistical Supplement, p. A-11.

1962-1963 Budget[1]

TOTAL EXPENDITURES	$638,370,017
Construction (including r-o-w)	$527,792,917
Maintenance	44,700,000
Administration	11,500,000

Other information pertaining to maintenance costs are included in the report to show that present costs for maintaining California highways are high and will steadily rise as additional segments of the Interstate System are completed and the demands of the motoring public for additional services increase.

Total expenditure for all maintenance work on state highways including upkeep and repair of the Benesia-Martinez Ferry, was $37,742,735 in 1960-1961.[2]

In 1960-1961 it cost $1,638,979 for removal of roadside litter and street sweepings.[3]

A total of $1,353,525 was spent for traffic striping and pavement markings by the state forces.[4]

During the year, repair and upkeep of state highway signs cost $646,884. This does not include the cost of work performed by cities or the cost of electricity.[5]

ALABAMA

Fiscal Year Ending September 30, 1961

Total receipts and balances	$160,379,339.16[6]
Construction Expenditures	113,556,182.74[7]

Maintenance Costs[8]

Routine	$ 8,392,336.00
Special Surface	2,357,043.21
Extraordinary	86,082.78
Interstate	34,751.55
	$10,870,213.54

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[1] Division of Highways, Department of Public Works, *California Highways and Public Works, Annual Report Issue, November-December 1961* (Sacramento, California), p. 72.

[2] *Ibid*, p. 22.

[3] *Ibid*, p. 23.

[4] *Ibid*, p. 23.

[5] *Ibid*, p. 24.

[6] Alabama State Highway Department, *Fiftieth Annual Report*, (Montgomery, Ala., 1961), p. 40.

[7] *Ibid*, p. 43.

[8] *Ibid*, p. 149.

The following is quoted from the Highway Director's comments in the *Fiftieth Annual Report*:

> Alabama has about 73,000 miles of roads — of which almost 9,000 miles are State highways. The remainder are city streets and county rural roads. Every day of the week, every week of the year, we are maintaining these State roads, repairing them, studying traffic patterns, and building new highways to better serve the motoring public.[1]
>
> Impressive advances were made during the year on Alabama's 878-mile portion of the nationwide Interstate and Defense Highway System. These four-lane, controlled-access throughways span the State, and several major sections — particularly between Montgomery and Birmingham — were opened during the spring. This is a long-range program, not due for completion for several more years, but several other segments are almost ready for traffic.[2]

The Alabama Interstate Highway Office reports that at the end of fiscal year 1961, 87 miles of Interstate Highways were open to traffic and that of the 877.3 miles of Interstate Highways allotted to the state, 92.6 miles were located in urban areas and 784.6 miles were located in rural areas.[3]

From the information available, Alabama spent $34,751.55 during the fiscal year ending September 30, 1961, to maintain 87 miles of interstate highways at an average cost of $400 per mile.[4] No explanation is given as to the functions of maintenance performed.

MINNESOTA

Biennial Report — July 1, 1958-June 30, 1960

Trunk Highway Fund 1959-1960[5]

Sources	
Highway User Revenue	$114,500,274
Federal Aid	127,786,675
Distribution	
Construction	$215,065,231
Maintenance and Plant and Equipment	37,715,803

Minnesota is presently studying future maintenance requirements for the interstate highways now under construction. The Commissioner reports that "estimates based on present experience and reports from other states now operating toll roads and freeways indicate the need for a substantial increase in equipment and personnel."[6]

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[1] Alabama State Highway Department, *Fiftieth Annual Report* (Montgomery, Ala., 1961), p. 5.

[2] *Ibid*, p. 6.

[3] *Ibid*, pp. 163-164.

[4] *Ibid*, p. 149.

[5] State of Minnesota, Department of Highways, *Biennial Report of the Commissioner of Highways, July 1, 1958, to June 30, 1960* (St. Paul, Minn.), p. 13.

[6] *Ibid*, p. 50.

The Commissioner reported that it cost approximately $250,000 to pick up debris and litter from the highway and, in comparative terms, this outlay exceeded the expenditure for labor, material and equipment required to paint traffic and guide lanes throughout the entire state.[1] The maintenance section is responsible for 11,832 miles[2] of trunk highways. The "routine" maintenance operations include such things as patching roadway surface, repairing and cleaning drainage structures, mowing right-of-way, erecting and repairing signs, sanding icy and hazardous surfaces, plowing snow and picking up debris and trash.[3]

NORTH CAROLINA

Biennial Report for the Fiscal Years
Ending June 30, 1959 and June 30, 1960

1959-1960 Highway Department Budget[4]

Total Budget	$127,300,000

State Maintenance and Construction

System	Maintenance	Construction
Primary	$16,000,000	$ 3,000,000
Secondary	33,000,000	12,000,000
Urban	2,500,000	500,000
TOTALS	$51,500,000	$15,500,000

North Carolina's maintenance and construction budget is carried as a single appropriation for maintenance and construction force account, and the Highway Commission segregates the budget as shown above.

The budget is further explained in the report:

> It is to be noted that routine upkeep or maintenance of the 71,344 mile State Highway System, amounting to $51,500,000, represents over 40% of the total operating budget of the Highway Department. This includes expenditures of approximately $8,800,000 for the use of 7,000 prisoners at a $5.00 per day cost.[5]

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[1] State of Minnesota, Department of Highways, *Biennial Report of the Commissioner of Highways,* July 1, 1958, to June 30, 1960 (St. Paul, Minn.), p. 50.

[2] *Ibid,* p. 48.

[3] *Ibid,* p. 49.

[4] North Carolina State Highway Commission, *Twenty-Third Biennial Report, 1958-1959 and 1959-1960* (Raleigh, N.C.), p. 13.

[5] *Ibid,* p. 13.

MAINE

Fiscal Year 1961

Highway Fund[1]

Fiscal 1960	$57,571,826.12
Fiscal 1961	54,958,697.77

Disbursements[2] (For fiscal year ending June 30, 1961)

State Financed Projects	$ 346,859
Urban Projects	1,486,906
Federal-State Financed Projects	5,385,214
Interstate Projects	12,718,102
TOTAL	$19,937,081

During fiscal 1961, 10,111 miles of road were maintained at a total cost of $8,096,635.36 (excluding snow removal costs). ". . . 60 per cent of the expenditure was made on the State Aid System and 40 per cent on the State Highway System, representing an average cost per mile of $706, and $1,004, respectively."[3]

State Snow Removal Costs by Function[4]

Function	Amount	Per Cent
Ice Control	$2,766,770	50
Reimbursements to Towns	1,233,812	22
Plowing	956,340	18
Snow Fence	230,102	4
Night Patrol	154,470	3
Supervision	142,288	3
Total Expended by State	$5,483,782	100
Expended by Towns	1,995,716	
GRAND TOTAL	$7,479,498	

Comparison of Snow Removal Data by Fiscal Year

	Accepted Mileage		Cost per Mile	
	1959-1960	1960-1961	1959-1960	1960-1961
State Highways	3,210	3,321	$1,269.31	$1,279.72
State Aid and Town Ways	12,770	12,729	242.27	254.71

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[1] Maine State Highway Commission, *Forty-Eighth Report — 1961* (Augusta, Maine), p. 77.

[2] *Ibid*, p. 17.

[3] *Ibid*, p. 49.

[4] *Ibid*, p. 50.

Table II showed that the current emphasis is on new construction. But highway administrators are faced with the problem of maintenance and especially the problem of financing maintenance on the Interstate System. Lack of historical maintenance-cost data and an ever increasing demand for additional emergency motorist services on the Interstate System have caused highway administrators to estimate future maintenance costs based on current operating costs. Even though these estimates are on the conservative side, they present a serious financial problem.

Table III emphasizes the heavy expenditures for maintenance purposes. Table III shows maintenance disbursements for state-administered highways for the year 1960 with an attempt to segregate maintenance costs as to function. New York leads with a total expenditure of $72,679,000 and Pennsylvania is next with $72,080,000. Texas is third with a total expenditure of $58,898,000. The largest expenditures for snow removal and ice control are reported by New York and Pennsylvania, while Texas reports $2,168,000 for this function.

TABLE III

MAINTENANCE DISBURSEMENTS FOR STATE-ADMINISTERED HIGHWAYS BY FUNCTIONS — 1960*

(In Thousands of Dollars)

	MAINTENANCE					
	Maintenance of Condition		Operating Maintenance			
State	*Roads*	*Structures*	*Snow Removal, Sanding, Etc.*	*Traffic Services*	*Operation of Roads, Bridges, Etc.*	TOTAL
Alabama	13,588	154	98	1,583	78	15,501
Alaska	5,902	—	—	—	142	6,044
Arizona	5,664	52	187	891	—	6,794
Arkansas	10,109	878	—	1,253	107	12,347
California	24,906	3,033	3,183	7,514	2,284	40,884
Colorado	5,804	83	1,872	1,439	79	9,277
Connecticut	11,101	282	4,319	197	3,453	19,352
Delaware	3,242	61	549	186	845	4,883
Florida	13,851	1,613	—	1,368	2,472	19,304
Georgia	10,092	—	—	779	260	11,131
Hawaii	2,331	166	—	344	—	2,841
Idaho	4,516	37	462	584	—	5,599

Illinois	22,907	674	5,135	3,633	1,498	33,847
Indiana	14,591	1,954	3,072	2,761	1,081	23,459
Iowa	9,118	151	4,265	1,837	—	15,371
Kansas	14,444	64	1,827	1,749	502	18,586
Kentucky	23,030	724	710	2,846	408	27,718
Louisiana	12,668	3,249	—	1,799	1,833	19,549
Maine	8,910	767	4,192	375	419	14,663
Maryland	7,811	560	1,823	904	1,540	12,638
Massachusetts	10,227	1,284	7,890	3,080	2,077	24,558
Michigan	12,820	1,112	9,590	1,789	244	25,555
Minnesota	11,614	291	3,267	1,790	—	16,962
Mississippi	9,153	197	67	664	82	10,163
Missouri	22,204	855	3,342	1,802	96	28,299
Montana	4,261	69	1,205	427	—	5,962
Nebraska	6,563	60	1,796	690	—	9,109
Nevada	2,699	9	544	768	—	4,020
New Hampshire	3,016	620	3,025	519	1,079	8,259
New Jersey	7,994	1,325	4,293	2,834	12,181	28,627
New Mexico	10,197	320	744	832	—	12,093
New York	28,750	2,658	12,399	2,569	26,303	72,679
North Carolina	46,987	4,453	1,857	388	318	54,003
North Dakota	4,108	53	479	356	—	4,996
Ohio	24,879	2,130	7,979	4,237	2,274	41,499
Oklahoma	12,033	396	264	1,320	538	14,551
Oregon	8,027	846	1,118	2,563	552	13,106
Pennsylvania	37,743	1,969	23,570	4,080	4,718	72,080
Rhode Island	3,152	429	684	459	927	5,651
South Carolina	14,298	717	227	1,285	175	16,702
South Dakota	4,822	48	664	227	—	5,761
Tennessee	9,652	—	492	—	—	10,144
Texas	45,681	842	2,168	9,732	475	58,898
Utah	3,753	26	982	782	—	5,543
Vermont	3,201	54	2,364	244	3	5,866
Virginia	27,101	820	4,504	1,046	6,498	39,969
Washington	6,102	638	2,602	1,331	7,951	18,624
West Virginia	26,934	—	3,872	—	210	31,016
Wisconsin	10,734	130	5,223	1,572	—	17,659
Wyoming	2,200	88	738	480	—	3,506
Total	645,490	36,941	139,643	79,908	83,666	985,648

*Source: United States Department of Commerce, Bureau of Public Roads, *Highway Statistics — 1960* (Washington: Government Printing Office, 1962), p. 105.

Table IV shows the estimated total disbursements for highways by all units of government for the year 1959. A study of this table shows that an estimated total of $2,481,519,000 was expended on highways. These tables show that states are presently spending huge sums for maintenance purposes and that future demands for more money for the maintenance of the Interstate System will pose a financial problem.

TABLE IV

ESTIMATED TOTAL MAINTENANCE DISBURSEMENTS FOR HIGHWAYS, ALL UNITS OF GOVERNMENTS— 1959*

(In Thousands of Dollars)

	MAINTENANCE				
State	State Administered Highways	Local Rural Roads	Local City Streets	Federal Roads and Unclassified	TOTAL
Alabama	13,253	21,948	8,477	—	43,678
Alaska	6,075	—	984	—	7,059
Arizona	6,305	3,664	3,098	632	13,699
Arkansas	12,492	11,806	5,569	—	29,867
California	37,406	40,490	58,008	211	136,115
Colorado	8,145	12,487	6,488	22	27,142
Connecticut	17,843	10,911	12,822	—	41,576
Delaware	4,679	—	548	—	5,227
Florida	17,246	22,368	16,780	4	56,398
Georgia	9,969	16,206	7,357	—	33,532
Hawaii	1,480	4,522	—	—	6,002
Idaho	6,748	7,410	2,459	191	16,808
Illinois	28,774	40,958	41,264	—	110,996
Indiana	23,082	29,019	17,207	—	69,308
Iowa	12,827	30,602	13,201	—	56,630
Kansas	16,901	29,463	6,949	6	53,319
Kentucky	29,429	11,441	8,497	—	49,367
Louisiana	19,082	17,771	8,055	—	44,908
Maine	16,116	3,335	5,827	—	25,278
Maryland	10,277	12,352	9,569	—	32,198
Massachusetts	21,556	7,360	29,755	—	58,671
Michigan	28,055	38,302	29,381	—	95,738
Minnesota	17,389	29,698	20,378	90	67,555
Mississippi	8,029	29,073	5,570	24	42,696
Missouri	26,013	14,137	14,700	—	54,850
Montana	5,491	8,310	2,444	260	16,505
Nebraska	8,122	15,765	5,999	23	29,909
Nevada	4,116	1,589	1,040	72	6,817
New Hampshire	8,815	2,930	5,807	—	17,552
New Jersey	28,433	27,835	25,142	—	81,410
New Mexico	9,236	3,186	2,289	261	14,972
New York	67,576	90,060	95,497	—	253,133
North Carolina	49,673	—	9,103	64	58,840
North Dakota	4,971	5,891	1,883	145	12,890
Ohio	32,062	73,808	38,258	—	144,128
Oklahoma	11,112	21,221	5,998	174	38,505
Oregon	13,253	10,876	3,458	243	27,830
Pennsylvania	62,682	27,720	41,336	—	131,738
Rhode Islnad	5,087	1,072	5,151	—	11,310
South Carolina	15,181	5,810	1,816	—	22,807
South Dakota	5,546	6,294	2,115	265	14,220

Tennessee	9,738	21,463	8,023	—	39,224
Texas	58,576	43,083	25,681	—	127,340
Utah	5,311	3,213	1,495	63	10,082
Vermont	4,961	5,068	2,159	—	12,188
Virginia	35,464	613	10,130	—	46,207
Washington	18,556	21,472	9,509	272	49,809
West Virginia	20,636	—	4,103	—	24,739
Wisconsin	17,816	38,258	20,396	126	76,596
Wyoming	4,518	1,864	1,250	50	7,682
Dist. of Columbia	—	—	4,426	33	4,459
Not distributed by States	—	—	—	22,010	22,010
Total	906,103	882,724	667,451	25,241	2,481,519

*Source: United States Department of Commerce, Bureau of Public Roads, *Highway Statistics — 1960* (Washington: Government Printing Office, 1962), p. 142.

Selected Current Maintenance Expenditures — Interstate System

Maintenance of highways is a state responsibility, but the foregoing data obviously raises questions: How is one to measure maintenance? How is one to know when maintenance is adequate or inadequate? Highway management officials, federal and state, lack the criteria to evaluate the adequacy of maintenance. They know how much is expended on maintenance, but they do not know how much adequate maintenance should cost. Present practice is to consider maintenance adequate as long as traffic moves on the highways, but what is needed is a tool which highway management officials can use to evaluate the maintenance work performed in each state and which can be used for making comparisons between states.

To be of value to highway officials, maintenance costs must be computed on the same base, but the limited experience of the states in the computation of cost records was illustrated during the 51st annual meeting of the Mississippi Valley Conference of State Highway Officials. Maintenance and equipment engineers were presented with the question of:

> Interstate average cost per mile (urban and rural), for: (a) snow and ice removal: (b) mowing costs; (c) cleaning and patrolling; and (d) resodding, mulching and erosion control.

In discussing these questions, the following consensus emerged:

Most states have had too limited experience for preservation of accurate costs on the individual items. Michigan reported that the cost of maintaining the Expressways in Detroit ranged from 20 to 29 thousand dollars per mile exclusive of the lighting system. Illinois reported that the cost of maintaining its Expressways in the Chicago area has been approximately $4,500 per mile for the highway lighting.[1]

Reports from other states emphasized the differences caused by such things as climatic conditions. For example, New Hampshire reported $4,000 as the cost of maintenance of the Interstate System per mile per year, of which $2,500 was directly chargeable to snow and ice control.

This lack of experience and wide variation in cost accounting was demonstrated in issues of *Better Roads* magazine, during 1962, with reports from several states on the nature and costs of their maintenance programs for all types of highways. This information is cited below as evidence of the need for standards not now employed.

NEW MEXICO[2]

H. F. Leslie, *Engineer of Maintenance,*
New Mexico State Highway Department

Mr. Leslie reports that his department does not have enough experience to determine what the maintenance cost per mile will be on the Interstate System. He reported that with the higher type of maintenance that motorists expect on the Interstate System, maintenance costs on the Interstate System will be higher than maintenance costs on New Mexico's existing highways.

For the fiscal year 1960-1961, New Mexico reported that it cost $950 per mile to maintain each two lanes of a four-lane divided highway with uncontrolled access.

NEW HAMPSHIRE[3]

E. B. Hodgins, *Assistant Maintenance Engineer,*
New Hampshire Department of Public Works and Highways

Mr. Hodgins reported that New Hampshire expended the following in 1961 for maintenance of its highways:

Interstate System — divided highways — $4,000 per mile, per year, total. $2,500 per mile per year, winter costs.

Regular State Highway System — Statewide — $2,500 per mile, per year.

Mr. Hodgins reported that park-like, grassy areas at urban interchanges were mowed every 10 days and that rubbish was picked up daily.

VIRGINIA[4]

S. V. Munsey, *Maintenance Engineer,*
Virginia Department of Highways

Mr. Munsey reported the following maintenance costs.

Ordinary maintenance, exclusive of any replacement activities.

(1) Shirley Memorial Highway, Virginia Route 350 near Washington, D. C. — $3,500-$4,000, per mile per year.

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[1] Mississippi Valley Conference of State Highway Departments, *51st Annual Meeting, 1960 Mississippi Valley Conference Report,* (Chicago: 1960), p. 181.

[2] *Better Roads,* 32:27, July, 1962.

[3] *Better Roads,* 32:16,44, April, 1962.

[4] *Better Roads,* 32:27-28, June 1962.

(2) Virginia Beach Boulevard, U. S. Route 58, near Norfolk, $4,000 per mile per year.

(3) Short sections of the Interstate System. $2,000-$3,000 per mile per year, first year. (Note: Practically all costs chargeable to mowing right-of-way and ice control.)

(4) *Estimated cost from other sources.*

a. Ordinary maintenance — Richmond-Petersburg Turnpike (toll facility) — $5,200-$5,600 per mile per year.

b. Interstate Route 64 approaches to the Hampton Roads bridge-tunnel crossing approximately $6,000 per mile.

Mr. Munsey further reported that ordinary maintenance costs on completed highway systems are estimated to be $4,000-$6,000 per mile per year. Needed replacements cost $3,000 per mile per year, bringing the costs to $7,000-$9,000 per mile per year. In urban and mountainous terrain, ordinary maintenance costs plus replacements over a period of years are estimated to be $10,000 per mile per year.

ILLINOIS[1]

Mr. R. H. Tittle, *Assistant Chief Highway Engineer,* reported that maintenance costs in 1960 totaled $32,044,000 for 15,336 miles of state-maintained highways and marked routes (special) at an average cost of $2,089.46 per mile.

CONNECTICUT[2]

Commissioner Howard S. Ives reported that it cost $5,500,000 to remove snow and ice from 3,500 miles of state-maintained highways during the winter of 1961-1962. This figure for winter maintenance costs included the spring clean-up of highways.

MASSACHUSETTS[3]

James F. Kelly, *Assistant Chief Engineer for Maintenance and Equipment,* Massachusetts Department of Public Works, reported the following:

There are 6,700 lane-miles in the State Highway System, and 1,800 lane-miles in the Interstate System.

The 1,800 lane-miles on the Interstate System will require an increase of $5,000,000 per year to pay for maintenance.

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[1] Mississippi Valley Conference of State Highway Departments, *52nd Annual Meeting, 1961 Mississippi Valley Conference Report* (Chicago: 1961), p. 17.

[2] *New England Construction,* 26:62, May 21, 1962.

[3] *Better Roads,* 32:16,30-31, May, 1962.

Massachusetts has experience with maintenance by contract and Mr. Kelly reported the following costs:

Catch Basins — 1954 — 1,100 C.B. @ $5.35 each
1961 — 30,000 C.B. @ $3.00 each

Signs and Delineators — actual cost by contract — $30,000 for 15 miles of rural highway: estimated $50,000 for same length in urban areas.

Other Massachusetts maintenance costs are indicative of the kind of information states will have to have in order to obtain correct maintenance cost figures in the future.

Chlorides and Salt — 250 pounds per lane-mile, sodium chloride, above 25° F.

250 pounds per lane-mile, mixture of calcium chloride and sodium chloride, below 25° F.

Maintaining Signs — Interstate System — $1,000 per mile per year in rural areas.

Maintaining Delineators — Interstate System — $200 per mile per year.

Traffic Lines — Interstate System. 9 miles of lines per mile of interstate highway. $80 per mile for material and labor. $720 per mile per year for pavement markings.

Summary — $2,420 per mile per year for signs, delineators, pavement markings.

Per Lane-Mile Per Year — Interstate System

$ 445 — signs, delineators, pavement markings
1,000 — physical maintenance
1,000 — snow and ice control
255 — other traffic services

$2,700 per lane-mile per year

Lighting — Full Cloverleaf — $14,000 per year per cloverleaf.

NORTH DAKOTA[1]

Mr. Ray Robinson, *Maintenance Engineer,*
North Dakota State Highway Department

North Dakota estimates $3,000 per mile per year to maintain Interstate Route 94. This estimated cost includes all kinds of maintenance for the four-lane highway.

KENTUCKY[1]

Mr. Guy Borders, *Assistant Director of Maintenance,*
Kentucky State Highway Department

Mr. Borders reported that no figures were available for maintenance costs. Kentucky hopes to hold maintenance costs at $4,000 per mile per year.

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[1] *Better Roads,* 32:44, April, 1962.

IOWA[1]

Mr. L. M. Clauson, *Chief Engineer,*
Iowa State Highway Commission

Mr. Clauson said that maintenance costs vary slightly from section to section of a highway depending on traffic volumes and terrain. From cost accounting records for 1958-1961, Iowa estimates that maintenance costs, exclusive of lighting costs, are $5,000-$6,000 per mile per year.

IDAHO[2]

Mr. Charles Aldrich, *Maintenance Engineer,*
Idaho Department of Highways

Mr. Aldrich reported the following maintenance costs: $1,000 per mile, per year — two-lane secondary highways. $1,200 per mile, per year — primary highways. $3,000 per mile, per year — four-lane Interstate Highway in northern Idaho.

WISCONSIN[3]

Mr. William F. Steuber, *Assistant State Highway Engineer*

Wisconsin maintains 11,000 miles of highways in its State Trunk Highway System and expended the following amounts during the calendar year 1960:

$10,800,000 — routine and special maintenance (14% over 1959)
5,400,000 — snow removal, ice control, drift prevention

$16,200,000 — Total for calendar year, 1960

Mr. Steuber reported that "steadily increasing maintenance costs are becoming a matter of major concern . . . ."

CALIFORNIA[4]

Mr. Edward L. Tinney, *Maintenance Engineer,*
California Division of Highways

Mr. Tinney has estimated that the cost of maintaining a typical mile of interstate highway is seven times the cost of maintaining a mile of typical two-lane conventional highway.

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[1] *Better Roads,* 32:14,26, March, 1962.

[2] *Better Roads,* 32:18,32, May, 1962.

[3] Mississippi Valley Conference of State Highway Departments, *52nd Annual Meeting, 1961 Mississippi Valley Conference Report* (Chicago: 1961), p. 56.

[4] *Better Roads,* 32:13,30, July, 1962.

OHIO[1]

Mr. J. W. Reppel, *Engineer of Maintenance,*
Ohio Department of Highways

The following is quoted directly from Mr. Reppel's report on maintenance costs:

> Present data on maintenance expenditures on the interstate system are not comprehensive enough to provide accurate maintenance cost information. A recent study, however, based on the premise of a completed system estimates that maintaining a four-lane rural and a four-lane urban mile will cost $7,794 and $10,740 per year, respectively, excluding lighting. Additional lanes will cost proportionately more.

To emphasize the fact that maintenance costs will continue to increase because of increasing demands of the highway user, the following information was presented on the cost of a particular service to the motorist — a courtesy patrol — conducted by the State of Ohio during a 30-day test period.[2]

Conditions:

2 motorist-aid test sections on Interstate Route 71
1 motorist-aid test section — 32.15 miles long
1 motorist-aid test section — 35.6 miles long
24 hour operation
15-day test run on each section during September, 1960
3 round trips per section, per 8-hour shift
Duration of test — 30 days
290 vehicles aided

Costs:

$1,584.00 labor
1,398.53 equipment

$2,982.53 total
$100 per day per courtesy patrol
$3 per day for each miles of interstate patrolled
$10 per vehicle aided

KANSAS[3]

> In 1961, approximately 18 million dollars was expended for maintenance. The cost per mile for rural two-lane highways averaged $1,770. A large part of this cost — $1,151 per mile — was attributed to surface maintenance alone.
>
> The trend in maintenance costs has shown a continuing increase in recent years. The 1961 cost of $1,770 per mile was an increase of 36 per cent over the 1956 cost of $1,300 per mile.
>
> . . . It is estimated that maintenance costs on the Interstate System will increase to approximately $4,500 per mile for rural sections and $5,500 per mile for urban sections.

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[1] *Better Roads,* 32:27, July, 1962.

[2] *Ibid,* p. 26.

[3] Roy Jorgensen and Associates, *Kansas Highway Needs* (Washington: 1962), pp. 69-70.

The Bureau of Public Roads in a press release, *Progress in Uniformity of Traffic Control Devices,* dated November 19, 1962, reported that Iowa will need 3.4 million dollars to complete its highway sign modification program. This $3.4 million is over and above its regular maintenance expenditure. This study of traffic control needs in Iowa, conducted by the Iowa State Highway Commission in cooperation with the Bureau of Public Roads and the Automotive Safety Foundation, disclosed the following:

> . . . on the rural portions of the primary highway system in Iowa, there were 107,000 signs in use. For the 8,800 miles covered, that averages about 12 signs per mile.
>
> But out of these 107,000 signs, 65,200 did not meet acceptable standards. Three out of every five signs in use on these main highways were not good enough. They were too small, or wrongly placed, or carried non-standard messages, and so on.
>
> Obviously, Iowa is going to have to spend a lot of money to improve this situation. Their study indicates it will cost $3.4 million to complete their highway sign and signal modernization. And this is over and above their regular maintenance costs for traffic control devices.
>
> The total cost of installing and maintaining proper traffic control devices on Iowa's State highways, over the next five years, is expected to be more than $12 million.

Assumed Maintenance Cost of Completed System

The lack of adequate maintenance cost statistics for the Interstate Highway System is recognized by all state engineers and is a problem that is common to all states. The need for better information for maintenance purposes is brought out in the following editorial, "Abundant Evidence," the April 1962 issue of *Better Roads.*

> . . . Most state engineers expect the cost of maintaining a four-lane divided highway to be three to four times that of maintaining a conventional two-lane highway. Estimates for interstate sections now completed run from $3,000 to $7,000 per mile per year. At an average of $5,000 per mile, that would mean that state highway departments will be spending $205,000,000 a year on interstate maintenance alone by the time the entire system is completed . . . .[1]

Estimated costs of maintaining the Interstate System by states are shown in Table V. Based on a very optimistic average cost of $5,000 per mile, the total cost to each state presents a clear financial burden.

At the present time, the states are spending huge sums for maintenance purposes and future demands for more money for new construction and maintenance purposes, not only for the Interstate System, but for all highways, will tax the patience and ingenuity of highway administrators.

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[1] Editorial Viewpoints, "Abundant Evidence," *Better Roads,* 32:5, April, 1962.

Reasons for Variations in Reporting Maintenance Costs

It is apparent that variations in maintenance costs as reported by the states are caused by many factors, most of which can be corrected. The annual maintenance costs seem, from the viewpoint of state highway officials, satisfactory. The costs tell all concerned that a certain amount of tax money was expended to maintain the highways in the state. There is no doubt in the motorist's mind that the money was well spent if he has full use of the highways all year round.

Naturally, states located in snow belts must expend more money keeping the highways open than those states more fortunately located. Highways located in areas subject to landslides or drifting sands must of necessity require more maintenance. Interstate highways in urban areas require elaborate lighting systems at interchanges because the highway user expects better highway lighting on those portions of the system traversing urban areas.

The above costs lumped together to give a total yearly maintenance cost per mile of highway will give a total cost figure suitable for an annual report, but they are wholly inadequate from the management viewpoint. Highway officials must have a common denominator for comparative purposes. Highway officials recognize the need for a new management tool because they are now living with the inadequate statistics that serve only to cloud the maintenance picture.

The following chapters will attempt to bring some order out of this existing chaos and suggest the tools appropriate for highway management.

TABLE V

ASSUMED ANNUAL COST OF MAINTENANCE OF COMPLETED INTERSTATE SYSTEM BY STATES*

(At $5,000 Per Mile Per Year)

State	Miles of Interstate System	Assumed Total Annual Maintenance Cost
Alabama	874.8	$ 4,374,000
Alaska	——	——
Arizona	1,161.0	5,805,000
Arkansas	517.8	2,489,000
California	2,178.2	10,891,000
Colorado	948.0	4,740,000
Connecticut	293.4	1,467,000
Delaware	40.5	202,500
Florida	1,120.0	5,600,000

Georgia	1,103.6	5,518,000
Hawaii	48.5	242,500
Idaho	612.1	3,060,500
Illinois	1,586.5	7,932,500
Indiana	1,120.9	5,604,500
Iowa	708.6	3,543,000
Kansas	801.1	4,005,500
Kentucky	696.1	3,480,500
Louisiana	682.6	3,413,000
Maine	312.0	1,560,000
Maryland	353.7	1,768,500
Massachusetts	462.5	2,312,000
Michigan	1,077.9	5,389,500
Minnesota	898.1	4,490,000
Mississippi	678.2	3,391,000
Missouri	1,104.7	5,523,500
Montana	1,180.4	5,902,000
Nebraska	489.8	2,449,000
Nevada	534.0	2,670,000
New Hampshire	213.8	1,069,000
New Jersey	375.9	1,879,500
New Mexico	1,005.2	5,026,000
New York	1,227.2	6,136,000
North Carolina	768.8	3,844,000
North Dakota	568.9	2,839,500
Ohio	1,495.2	7,476,000
Oklahoma	794.0	3,970,000
Oregon	731.3	3,656,500
Pennsylvania	1,575.5	7,877,500
Rhode Island	70.9	354,500
South Carolina	678.9	3,394,500
South Dakota	678.9	3,394,500
Tennessee	1,047.6	5,238,000
Texas	3,026.5	15,132,500
Utah	934.9	4,674,500
Vermont	323.9	1,619,500
Virginia	1,053.1	5,265,500
Washington	725.6	3,628,000
West Virginia	522.7	2,613,500
Wisconsin	452.5	2,262,500
Wyoming	914.6	4,573,000
District of Columbia	28.1	141,000

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*Source: United States Department of Commerce, Bureau of Public Roads, *Quarterly Report on the Federal-Aid Highway Program,* June 30, 1962 (Washington: Government Printing Office, 1962), Table I.

CHAPTER III

DEFINITIONS OF MAINTENANCE

Obviously maintenance costs, as currently being reported by the states, cannot be used for comparative or management purposes because there is not at present a nationally accepted definition and usage of "maintenance." Each state reports its maintenance costs differently. For example, every state in the Union builds roads, improves roads, maintains roads and operates facilities on the highways. These activities are often divided into two classes of work: (1) construction, which can be subdivided into construction, reconstruction, and betterments; and (2) maintenance, which can be subdivided into physical maintenance and traffic services. While these classifications are now in general use among states, each state defines the classes differently. An operation that one highway department considers "maintenance" is called a "betterment," or even "construction," in another state.

To overcome this inconsistency and make certain that maintenance costs of the Interstate System can be compared, there must be a nationally accepted definition of maintenance. The logical source for such a definition is the *Manual of Uniform Highway Accounting Procedures*[1] and the recommendation presented in this study, if accepted by all the states, would yield information about highways indispensable to future administration.

At the present time there seems to be a general acceptance of the meaning of the terms "construction," and "maintenance." All states agree in a broad sense that construction is the provision of a highway on a new location, while maintenance is the upkeep of the highway in a serviceable condition. These two general classifications must be further divided for clarification. Construction should be divided into two classes: (1) new construction; and (2) reconstruction, separate but equal to new construction. Reconstruction, the substantial improvement of an existing highway, should be considered equal to and placed at the same level of work as new construction.

Maintenance must be separated into two work operations, now commonly classed together as maintenance: (1) that process which repairs and preserves a highway should be called physical maintenance; and (2) that which serves the motorist, but is not necessary for the upkeep of the highway, such as operation of signals and lights and snow and ice control, should be called traffic service. These operations are so different and the costs of traffic services are so dependent upon climate and other factors that they must be defined as two general subdivisions of maintenance so they can be separated logically in cost accounting.

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[1] American Association of State Highway Officials, *Manual of Uniform Highway Accounting Procedures* (Washington: By The Association, 1960).

Items of maintenance as defined by the American Association of State Highway Officials are as follows:[1]

Physical Maintenance

> Physical maintenance is "the preservation and upkeep of a highway, including all its elements, in as nearly as practicable its original as constructed condition or its subsequently improved condition."

Traffic Services

> Traffic services is defined as "the operation of a highway facility, and services incidental thereto, to provide safe, convenient and economical highway transportation."

Unusual or Disaster Operations

> "Extensive repair or replacement due to damage as a result of storm, flood or military operations may be considered as extraordinary maintenance, betterment, reconstruction, or even as construction. Each case should be considered separately and usually it is advantageous to keep all such accounts together under the heading of Unusual or Disaster Operations."[2]

The preceding definitions point to the necessity of a logical separation of operating functions which are now considered as one maintenance operation. The complete disregard of proper classification of these three categories of maintenance seems to be the main reason why maintenance costs currently being reported by states cannot be compared and vary so extensively.

Furthermore, not only is it useful to follow in practice the definitions of maintenance categories, but they also provide the framework within which a specific, recommended accounting system may be employed. If states would adopt the three maintenance categories and the accounting system fitted to these categories recommended in the *Manual of Uniform Highway Accounting,* the problems of reporting maintenance expenditures for purposes of management would be largely solved. The only remaining problem would be to adopt a standard unit to which cost accounts could be applied. Before turning to the problem of a standard unit, it will be useful to set forth the accounting system, as recommended:

MAINTENANCE COSTS (FUNCTIONAL)

Block II Function

400 Physical or general maintenance
  410 Routine roadway surface operations:
    411 Patching
    412 Dragging
    413 Joint and crack filling
    417 Dust palliatives
    419 Other costs

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[1] The following discussion is based on *Manual of Uniform Highway Accounting Procedures,* pp. 3, 9, 62.

[2] *Ibid,* pp. 3-9.

420 Special roadway surface operations:
  - 421 Mud jacking and undersealing
  - 423 Replacing in kind
  - 424 Scarifying and remixing
  - 425 Bituminous treatment
  - 426 Resurfacing (bituminous less than ¾" in thickness)
  - 427 Protection and handling of traffic during the above operations
  - 429 Other costs

440 Shoulders and side approaches:
  - 441 Patching
  - 442 Reseeding and resodding
  - 443 Bituminous resealing
  - 444 Replacing in kind
  - 445 Reshaping
  - 449 Other costs

460 Roadside and drainage:
  - 461 Cuts, fills and washouts
  - 462 Drainage channels and structures
  - 463 Cleaning for drainage
  - 464 Cleaning and repairing catchment basins
  - 465 Walls, cribbing and riprap
  - 466 Trees, shrubs and planting
  - 467 Mowing and weed control
  - 468 Reseeding and resodding
  - 479 Other costs

480 Structures:
  - 481 Repairing and maintaining grade separation structures
  - 482 Repairing and maintaining walls
  - 483 Repairing and maintaining sewer and drainage systems
  - 484 Repairing and maintaining subways
  - 487 Repairing and maintaining tunnels
  - 488 Repairing and maintaining viaducts
  - 490 Repairing and maintaining dams
  - 491 Repairing and maintaining underpasses
  - 492 Repairing and maintaining overpasses
  - 494 Repairing and maintaining bridges
  - 497 Repairing and maintaining permanent snow fences
  - 499 Other costs

Block II Functional

500 Traffic Services:

510 Snow, ice and sand
  - 511 Snow removal
  - 512 Erection and removal of temporary snow fences
  - 513 Sanding icy surfaces
  - 514 Application of chemicals
  - 515 Ice removal
  - 516 Opening of inlets and drainage channels
  - 517 Removal of sand drifts

530 Traffic control and service facilities:
  531 Painting of strips and markings
  532 Repairing, maintaining and operating electrical signal equipment
  533 Repairing, maintaining and operating traffic signs
  534 Repairing and maintaining guard rails
  535 Repairing and maintaining right-of-way fences
  538 Repairing and maintaining highway lighting system
  541 Repairing and maintaining picnic fixtures
  542 Repairing and maintaining comfort stations
  546 Repairing and maintaining information booths
  547 Repairing and maintaining historical landmarks, tablets, etc.
  548 Repairing and maintaining weighing and inspection facilities
  549 Repairing and maintaining pedestrian faciliities
  550 Repairing and maintaining roadside rest areas and picnic grounds
  553 Detours not chargeable to construction
560 River Crossings:
  561 Operation of ferries
  563 Operation of drawbridges
  569 Other costs
570 Other Services:
  571 Towing and ambulance service
  572 Fire fighting service
  573 Litter cleaning
  575 Operation of information booths
  579 Other costs
600 Unusual or Disaster Maintenance:
  601 Floods and washouts
  602 Tornadoes and cyclones
  603 Sandstorms
  604 Blizzards
  605 Major slides
  606 Earthquakes
  607 Settlements
  608 Accidents
  609 Military operations
  610 Barricades
  619 Other disaster or unusual maintenance
650 Maintenance — General Functions:
  651 Field maintenance supervision

This system of accounts (for maintenance work) has been designed to provide for a uniform classification of maintenance transactions so that each state may use the same interpretation and composition. Only by a determined effort to keep physical maintenance, traffic services and unusual or disaster operations separate, will it be possible to arrive at maintenance costs that are comparable.

A Common Denominator for Accounting and Reporting

Because highways in the Interstate System differ as to the number of lanes constructed for use, the width of medians and rights-of-way, the complexity of interchanges, and in many other respects, a work unit for purposes of accounting for and reporting of maintenance expenditures such as mere "miles" clearly will not suffice. Thus, a reported figure of $3,000 per "mile" per year for maintenance purposes, even if maintenance costs were accounted for under the recommended accounting system, would give no indication as to the nature of the highway being reported on — whether it was four lane or six lane, whether it included wide or narrow rights-of-way, etc. What is needed, instead, is a common denominator for purposes of cost accounting and reporting, which will allow many variables to be reduced to a meaningful and significant indicator.

It has already been suggested that a distinction between "urban lane-miles" and "rural lane-miles" is useful in discussing the differential costs that are likely to be encountered in maintaining rural and urban sections of the Interstate System. Not only does the "urban"/"rural" distinction have its uses, but the lane-mile concept seems to offer the common denominator needed for management purposes. If used properly, it can furnish an excellent basis for comparing maintenance costs on qualitatively different sections of highway. Consequently, the author presents the following proposal for the definition of a "lane-mile" recognizing that further widespread discussion would probably offer improvements:

For maintenance purposes, a lane-mile shall be one travel lane, 12-feet wide, one mile long. In urban areas, it shall be called an urban lane-mile; in rural areas, it shall be called a rural lane-mile.

Facilities within the right-of-way, such as interchanges, ramps, bridges, grade separations and service roads (maintained by the state) shall have the mileage of the pavements or areas included in the total number of lane-miles maintained by the state. Pavements at interchanges and ramps wider than the specified 12 feet shall be considered as lanes, 12 feet wide.

All facilities and construction within the limits of the right-of-way shall be considered facilities placed therein to service the travel lanes and preserve the integrity of the travel lanes.

Preventive maintenance, physical maintenance, housekeeping maintenance, and traffic services shall be considered items of work performed to keep the travel lanes operating at design efficiency. The cost of the above maintenance items shall be reduced and reported as costs per urban lane-mile or rural lane-mile.

In Chapter I it was shown that there are approximately 32,000 miles of urban lane-miles in the Interstate System. The highway user will demand that sections of the Interstate System in urban areas be maintained so as to be in superior condition at all times and that the traffic services be the best that financial resources permit. The motorist now demands, for example, that states practice the "bare pavement" policy in snow removal operations. Interchanges and off-ramps and on-ramps are closely spaced in urban areas. The removal of snow on these facilities is costly. The high cost of the right-of-way dictates a minimum of land taking. This in turn leaves practically no storage area for snow when required and increases the cost of snow removal. Grassy areas along the right-of-way in urban areas must be frequently cut.

Routine houskeeping maintenance in urban areas will be costly. Sweeping and cleaning the interstate highway will be a frequent operation, and, by necessity, restricted to periods of low traffic volumes with the result of increased costs. Litter pick-up will be a constant chore. One factor alone, the cost of lighting facilities at interchanges and on sections of the interstate highway in urban areas, will increase the lane-mile maintenance cost of the system in urban areas substantially over that of rural areas.

Of the 170,000 lane-miles in the Interstate System, 138,000 miles are located in rural areas or approximately 80 per cent. However, it cannot at this time be said that maintaining the rural sections of the Interstate System will cost more or less than maintaining the urban sections in terms of total dollars. Present information points to a low cost per lane-mile for maintenance of a rural section of the Interstate System; but only sufficient historical data will decide whether maintenance cost per rural lane-mile is greater or less than the maintenance cost per urban lane-mile. This determination can only be made, of course, through the use of comparable cost accounting systems and the standard unit.

Today, highway planning and construction are the glamorous phases of the Interstate System. Maintenance is a "necessary evil." But as the Interstate System nears completion, the pendulum must swing in the opposite direction. Maintenance of the Interstate Highway System must start immediately after the ribbon-cutting ceremony. It must be a continuous program. Highway officials must start now to think about the administrative and financial problems involved. As of June 30, 1962, over 12,500 miles of the 41,000 miles of the National System of Interstate and Defense Highways were open to traffic. Assuming that maintenance of the completed portions costs $5,000 per mile, then the states must find $60,000,000 a year to purchase the required maintenance, beginning immediately.

Highway officials must prove that the amount requested for maintenance of the Interstate System is the amount needed. There is only one way and that way is by accurate cost figures. Just as right-of-way costs and construction costs are detailed, so must maintenance costs be detailed. Only then will administrative officials be in a position to justify their financial needs and be certain of meeting their responsibility to maintain the Interstate System.

Accurate cost accounting figures obtained through the implementation of the *Manual of Uniform Highway Accounting Procedures* and reported as maintenance costs per urban lane-mile and rural lane-mile for the three categories of maintenance: (1) physical maintenance, (2) traffic services or highway operations, and (3) unusual or disaster operation, will insure that the monies which are requested for maintenance purposes are adequate to do the job. With cost figures available, administrative officials will be able to prove to all concerned that the state's responsibility for maintenance of the Interstate System is properly being met.

CHAPTER IV

RECOMMENDATION FOR REIMBURSEMENT PROCEDURE TO THE STATES

The mechanics of reimbursement are simple to use, understand and administer. From the state administrator's viewpoint, reimbursement would be made on the basis of information and records that the state maintains and keeps current. From the federal administrator's viewpoint, reimbursement must be made on the basis of maintenance records which show what was done, why it was done, and how much it cost. Once this information was made available by the states to the Bureau of Public Roads, federal highway administrators would be able to set standards of maintenance, enforce these standards, and compare the costs of state maintenance to insure that the federal investment of $41,000,000,000 in the Interstate System is properly protected.

Before any system of federal grants for maintenance of the Interstate System can be implemented, the following steps must first be accomplished:

1. Acceptance of a definition of a maintenance lane-mile and especially definitions of a rural lane-mile for those portions of the Interstate System in rural areas, and an urban lane-mile for those sections of the Interstate System located in urban areas.
2. Acceptance of categories of maintenance such as those defined in the American Association of State Highway Officials publication, *Manual of Uniform Highway Accounting Procedures.*
3. Implementation of maintenance accounting such as set forth in the American Association of State Highway Officials publication, *Manual of Uniform Highway Accounting Procedures.*
4. Acceptance of federal reimbursement for actual costs of maintaining the system only as supported by cost accounts.
5. Acceptance of the fact that variations in reimbursement will exist.
6. The federal government must set maintenance standards for the system and the states must agree to accept those standards.
7. The United States Congress should authorize the Bureau of Public Roads to obtain funds for reimbursement from the Highway Trust Fund.

Present federal administrative procedures set up for reimbursement for construction expenditures can be used for reimbursing maintenance expenditures. There exist now at the federal level all the elements needed to implement the proposal that the federal government pay for maintaining the Interstate System except the necessary legislation. There is reason to believe that appropriate action will be taken at the national level once the need for the legislation is brought to the attention of Congress.

At the state level, much work has to be done before a reimbursement procedure can be put into operation. Fortunately, state highway administrators have the necessary administrative and maintenance forces already trained and available to implement the proposal. State administrators have access to the *Manual of Uniform Highway Accounting Procedures* and they are cognizant of the financial and administrative problems presented by the maintenance of the Interstate System.

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